INTEGRATED CIRCUITS

DATA SHEET

TEA5710; TEA5710T

AM/FM radio receiver circuit

Product specification
File under Integrated Circuits, IC01

March 1994

Philips Semiconductors

PHILIPS

FEATURES

- Wide supply voltage range: 2.0 to 12 V
- Low current consumption: 7.5 mA at AM, 9.0 mA at FM
- High selectivity with distributed IF gain
- LED driver for tuning indication
- High input sensitivity: 1.6 mV/m (AM), 2.0 μV (FM) for 26 dB S/N
- Good strong signal behaviour: 10 V/m at AM, 500 mV at FM
- Low output distortion: 0.8% at AM, 0.3% at FM
- Designed for simple and reliable PC-board layout
- High impedance MOSFET input on AM

APPLICATIONS

- Portable AM/FM radio
- Clock radio
- Personal headphone radio

DESCRIPTION

The TEA5710 is a high performance Bimos IC for use in AM/FM radios. All necessary functions are integrated: from AM and FM front-end to detector output stages.

QUICK REFERENCE DATA

Conditions AM: f_i = 1 MHz; m = 0.3; f_m = 1 kHz; V_P = 3.0 V; measured in Fig.4 with S1 in position B and S2 in position A, unless otherwise specified. Conditions FM: f_i = 100 MHz; Δf = 22.5 kHz; f_m = 1 kHz; V_P = 3.0 V; measured in Fig.4 with S1 in position B and S2 in position A, unless otherwise specified.

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_P	positive supply voltage	2.0	–	12	V
I_P	supply current				
	in AM mode	5.6	7.5	9.9	mA
	in FM mode	7.3	9.0	11.2	mA
T_{amb}	operating ambient temperature range	–15	–	+60	°C
AM performance					
V_{in1}	RF sensitivity	40	55	70	μV
V_{13}	AF output voltage	36	45	70	mV
THD	total harmonic distortion	–	0.8	2.0	%
FM performance					
V_{in3}	RF sensitivity	1.0	2.0	3.8	μV
V_{13}	AF output voltage	47	58	69	mV
THD	total harmonic distortion	–	0.3	0.8	%

ORDERING INFORMATION

EXTENDED TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
TEA5710	24	SDIL	plastic	SOT234AG(1)
TEA5710T	24	SO24L	plastic	SOT137A(2)

Notes

1. SOT234-1; 1996 August 27.
2. SOT137-1; 1996 August 27.

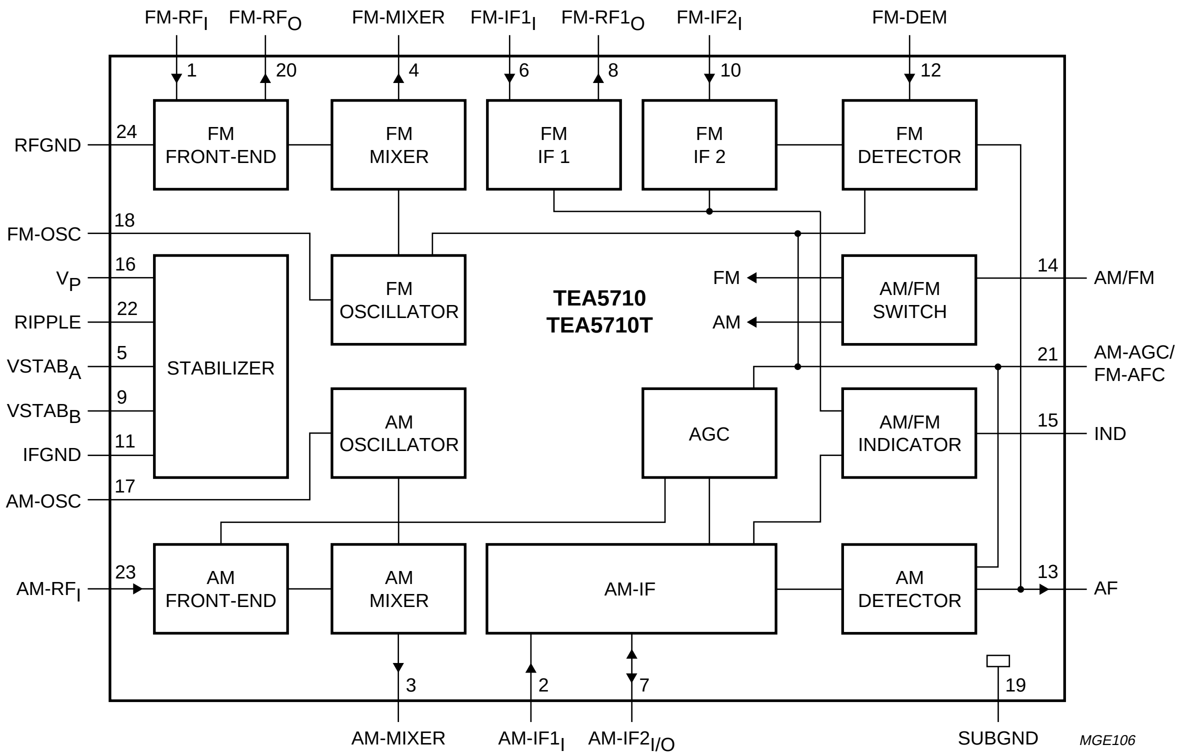


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
$FM\text{-}RF_I$	1	FM-RF aerial input (input impedance typ. 50 Ω)
$AM\text{-}IF1_I$	2	input from IFT or ceramic filter (input impedance typ. 3 kΩ)
AM-MIXER	3	open-collector output to IFT
FM-MIXER	4	output to ceramic IF filter (output impedance typ. 330 Ω)
$VSTAB_A$	5	stabilized internal supply voltage (A)
$FM\text{-}IF1_I$	6	first FM-IF input (input impedance typ. 330 Ω)
$AM\text{-}IF2_{I/O}$	7	input/output to IFT; output: current source
$FM\text{-}IF1_O$	8	first FM-IF output (output impedance typ. 330 Ω)
$VSTAB_B$	9	stabilized internal supply voltage (B)
$FM\text{-}IF2_I$	10	second FM-IF input (input impedance typ. 330 Ω)
IFGND	11	ground of IF and detector stages
FM-DEM	12	ceramic discriminator pin
AF	13	audio output (output impedance typ. 5 kΩ)
AM/FM	14	switch terminal: open for AM; ground for FM
IND	15	field-strength dependent indicator
V_P	16	positive supply voltage
AM-OSC	17	parallel tuned AM-OSC circuit to ground
FM-OSC	18	parallel tuned FM-OSC circuit to ground
SUBGND	19	substrate and RF ground
$FM\text{-}RF_O$	20	parallel tuned FM-RF circuit to ground
AM-AGC/FM-AFC	21	AGC/AFC capacitor pin
RIPPLE	22	ripple capacitor pin
$AM\text{-}RF_I$	23	parallel tuned AM aerial circuit to ground (total input capacitance typ. 3 pF)
RFGND	24	FM-RF ground

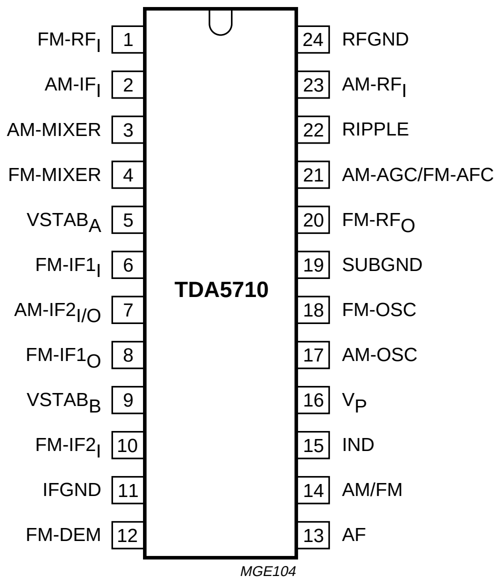


Fig.2 Pin configuration TEA5710.

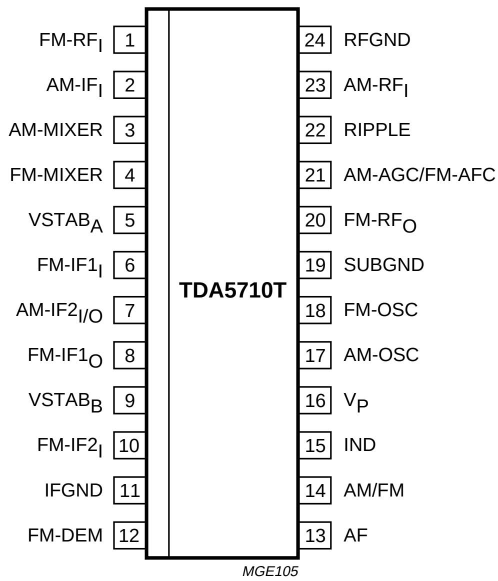


Fig.3 Pin configuration TEA5710T.

FUNCTIONAL DESCRIPTION

The TEA5710 incorporates internal stabilized power supplies. The maximum supply voltage is 12 V, the minimum voltage can go down temporarily to 1.8 V without any loss in performance.

The AM circuit incorporates a double balanced mixer, a one pin low-voltage oscillator (up to 30 MHz), a field-strength dependent indicator output and is designed for distributed selectivity.

The AM input is designed to be connected to the top of a tuned circuit. AGC controls the IF amplification and for large signals it lowers the input impedance.

The first AM selectivity can be an IFT as well as an IFT combined with a ceramic filter; the second one is an IFT.

The FM circuit incorporates a tuned RF stage, a double balanced mixer, a one-pin oscillator, a field-strength indicator output and is designed for distributed IF ceramic filters. The FM quadrature detector uses a ceramic resonator.

LIMITING VALUES

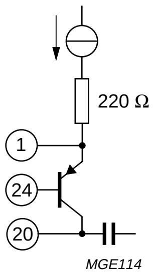
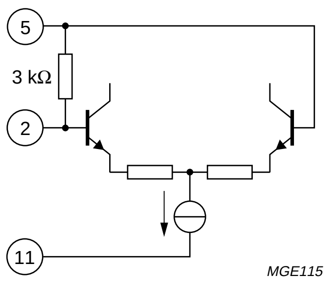
In accordance with the Absolute Maximum Rating System (IEC 134)

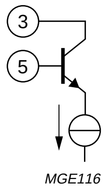
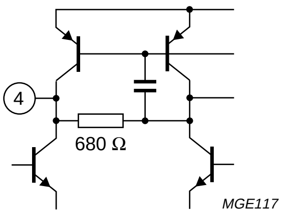
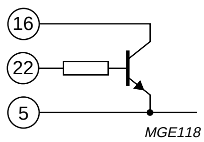
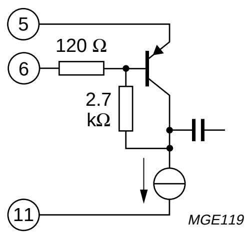
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_P	positive supply voltage	0	12	V
T_{stg}	storage temperature range	–55	+150	°C
T_{amb}	operating ambient temperature range	–15	+60	°C
T_j	junction temperature range	–15	+150	°C

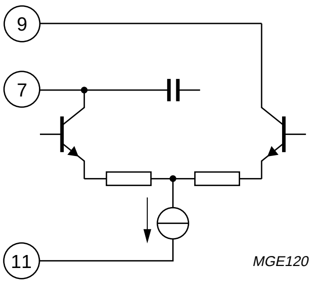
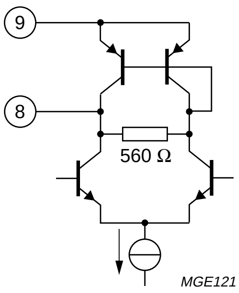
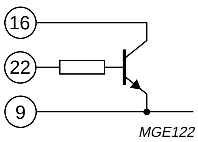
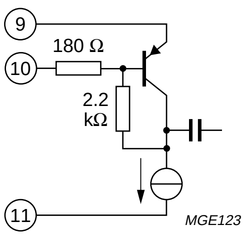
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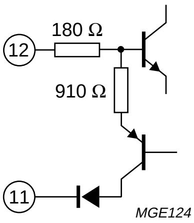
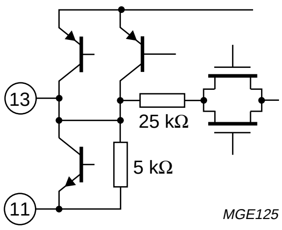
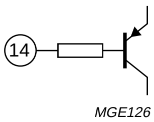
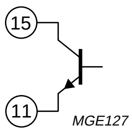
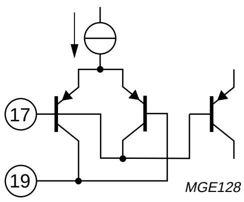
SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	from junction to ambient		
	for SDIL version TEA5710	69	K/W
	for SO24L version TEA5710T	76	K/W

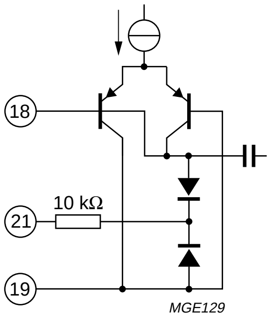
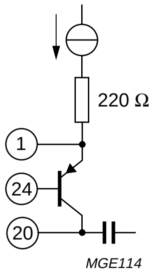
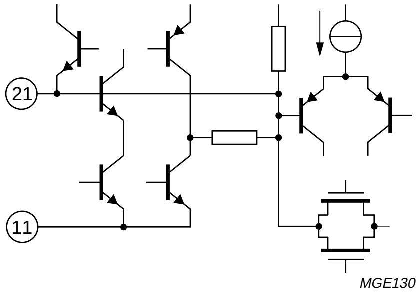
CIRCUIT DESIGN DATA

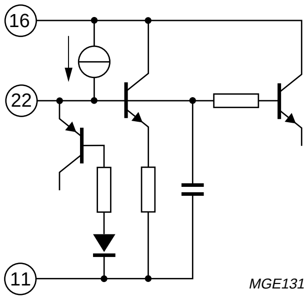
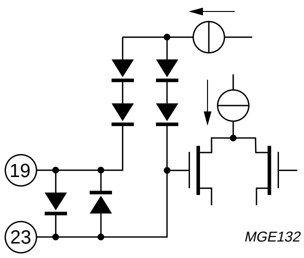
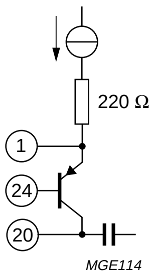
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<tr><th rowspan="2">PIN NO.</th><th rowspan="2">PIN SYMBOL</th><th colspan="2">DC PIN VOLTAGE (V)</th><th rowspan="2">EQUIVALENT CIRCUIT</th></tr>
<tr><th>AM</th><th>FM</th></tr>
<tr><td>1</td><td>FM-RF$_I$</td><td>–</td><td>0.73</td><td>
</td></tr>
<tr><td>2</td><td>AM-IF1$_I$
input</td><td>1.4</td><td>1.4</td><td>
</td></tr>
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PIN NO.	PIN SYMBOL	DC PIN VOLTAGE (V)		EQUIVALENT CIRCUIT
		AM	FM	
3	AM-MIXER output	1.4	1.4	
4	FM-MIXER output	–	1.0	
5	$VSTAB_A$	1.4	1.4	
6	$FM\text{-}IF_I$ input	–	0.73	

PIN NO.	PIN SYMBOL	DC PIN VOLTAGE (V)		EQUIVALENT CIRCUIT
		AM	FM	
7	AM-IF2$_{I/O}$ input/output	1.4	1.4	
8	FM-IF1$_O$ output	–	0.69	
9	VSTAB$_B$	1.4	1.4	
10	FM-IF2$_I$ input	–	0.73	
11	IFGND	0	0	

PIN NO.	PIN SYMBOL	DC PIN VOLTAGE (V)		EQUIVALENT CIRCUIT
		AM	FM	
12	FM-DEM	–	1.0	
13	AF output	0.6	0.7	
14	AM/FM switch	1.3	0	
15	IND	3.0	3.0	
16	V_P	3.0	3.0	
17	AM-OSC	0	0	

PIN NO.	PIN SYMBOL	DC PIN VOLTAGE (V)		EQUIVALENT CIRCUIT
		AM	FM	
18	FM-OSC	0	0	
19	SUBGND	0	0	
20	FM-RF_O	0	0	
21	AM-AGC/ FM-AFC	0.1	0.7	

PIN NO.	PIN SYMBOL	DC PIN VOLTAGE (V)		EQUIVALENT CIRCUIT
		AM	FM	
22	RIPPLE	2.1	2.1	
23	AM-RF_I	0	0	
24	RFGND	0	0	

AM CHARACTERISTICS

f_i = 1 MHz; m = 0.3; f_m = 1 kHz; V_P = 3.0 V; measured in Fig.4 with S1 in position B and S2 in position A, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_P	supply current	no input signal	5.6	7.5	9.9	mA
C_i	input capacitance	V_{21} = 0.2 V	–	3	–	pF
G_c	front-end conversion gain	V_{21} = 0.2 V	1.8	3.3	5.0	
V_{in1}	RF sensitivity	S/N = 26 dB	40	55	70	μV
V_{in2}	IF sensitivity	V_{13} = 30 mV; S_1 in position A	0.13	0.2	0.45	mV
V_{13}	AF output voltage	V_{in2} = 3.16 mV; S_1 in position A	36	45	70	mV
THD	total harmonic distortion	V_{in1} = 1 mV	–	0.8	2.0	%
V_{in1}	large signal handling	m = 0.8; THD ≤ 8%	150	300	–	mV
I_{IND}	indicator current	V_{in2} = 100 mV; S_1 in position A	2	3.5	6	mA
I_{INDOFF}	indicator OFF current	V_{in2} = 0 V; S_1 in position A	–	0	10	μA

FM CHARACTERISTICS

f_i = 100 MHz; Δf = 22.5 kHz; f_m = 1 kHz; V_P = 3.0 V; measured in Fig.4 with S1 in position B and S2 in position A, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_P	supply current	no input signal	7.3	9.0	11.2	mA
V_{in3}	RF limiting sensitivity	V_{13} = –3 dB	0.4	1.2	3.8	μV
V_{in3}	RF sensitivity	S/N = 26 dB	1.0	2.0	3.8	μV
V_6/V_{in3}	front-end voltage gain	V_{in3} ≤ 1 mV; including ceramic filter K1	12	18	22	dB
V_{in4}	IF sensitivity	S_2 in position B; V_{13} = –3 dB	–	20	30	μV
V_{13}	AF output voltage	V_{in3} = 1 mV	47	58	69	mV
THD	total harmonic distortion	V_{in3} = 1 mV; Δf = 22.5 kHz	–	0.3	0.8	%
V_{in3}	large signal handling	THD ≤ 5%	–	500	–	mV
I_{IND}	indicator current	V_{in4} = 100 mV; S_2 in position B	2	3.5	6	mA
I_{INDOFF}	indicator OFF current	V_{in4} = 0 V; S_2 in position B	–	0	10	μA

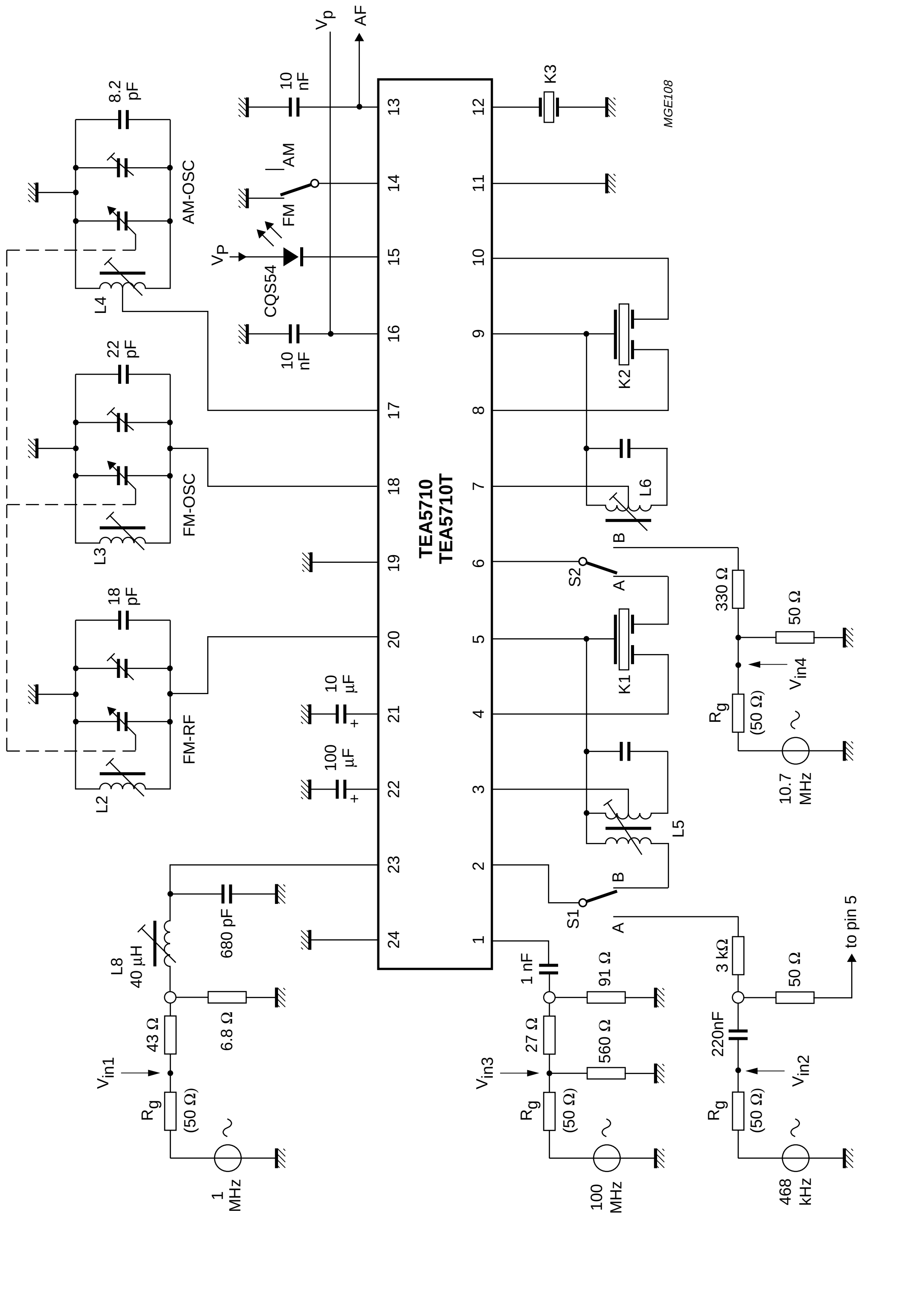


Fig.4 Test circuit.

APPLICATION INFORMATION

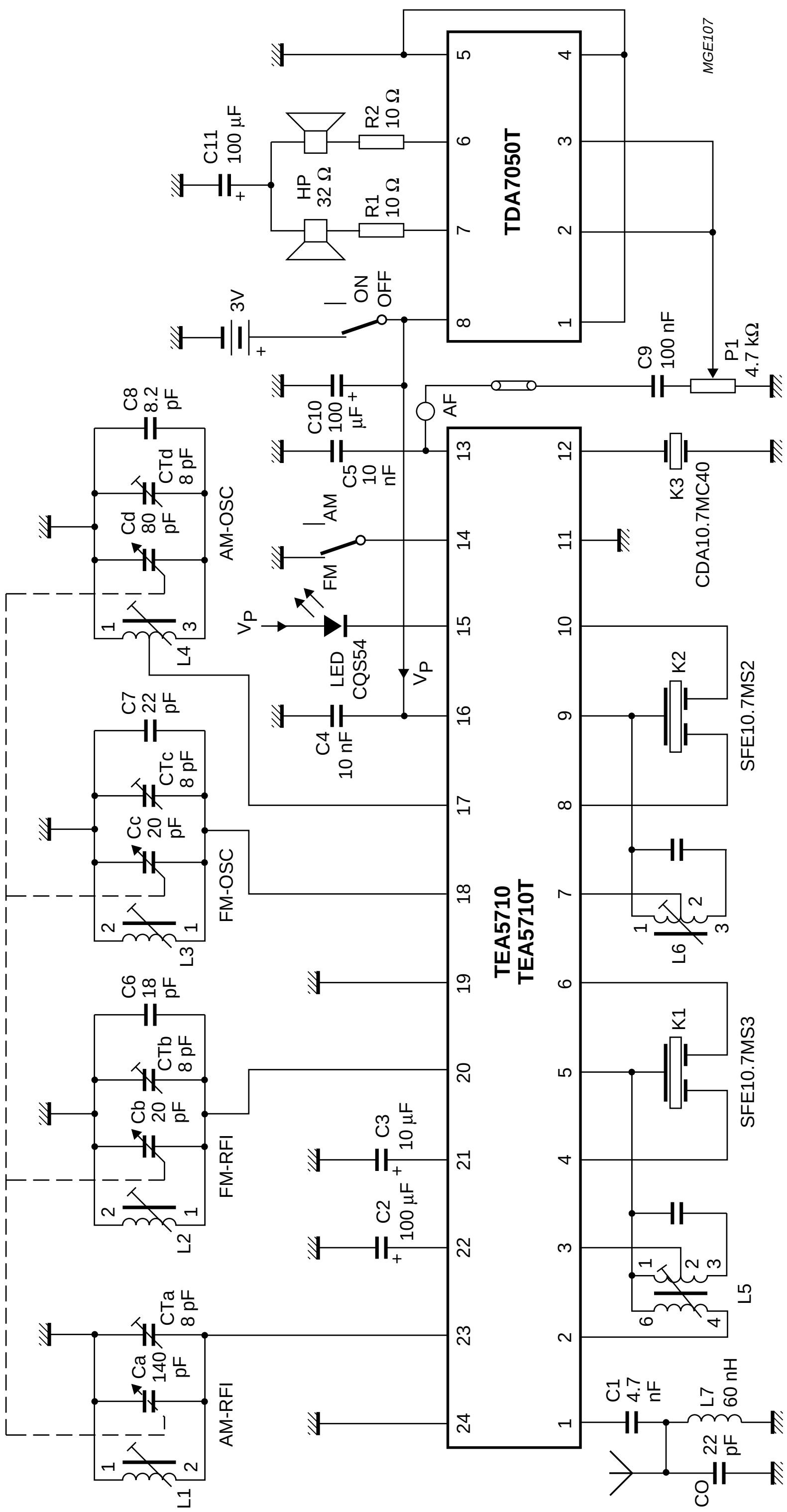


Fig.5 Application circuit of TEA5710 (AM: 522 to 1611 kHz, FM: 87.5 to 108 MHz) with stereo headphone amplifier TDA7050T.

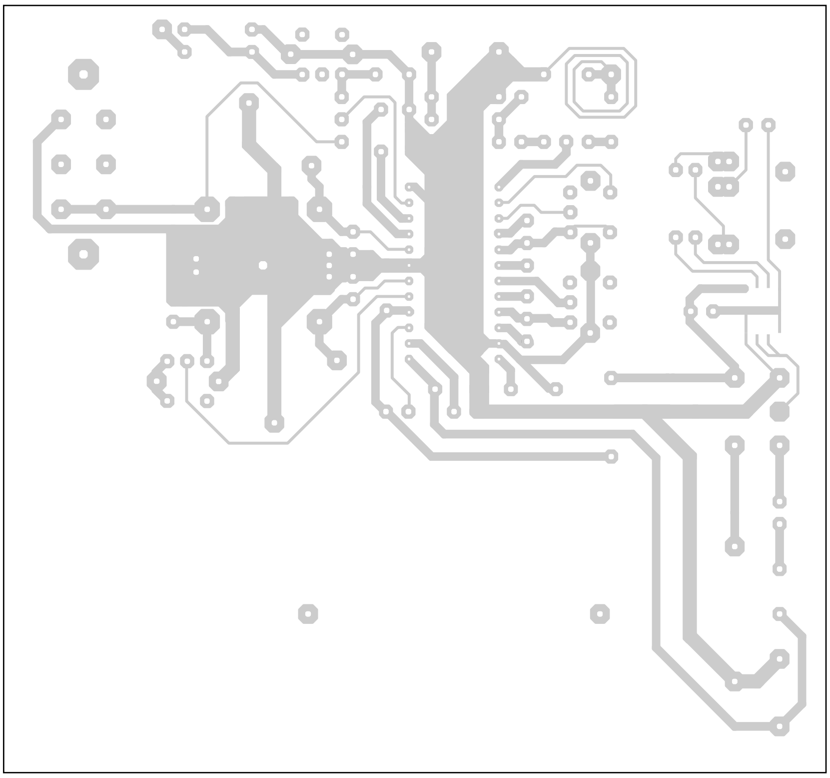
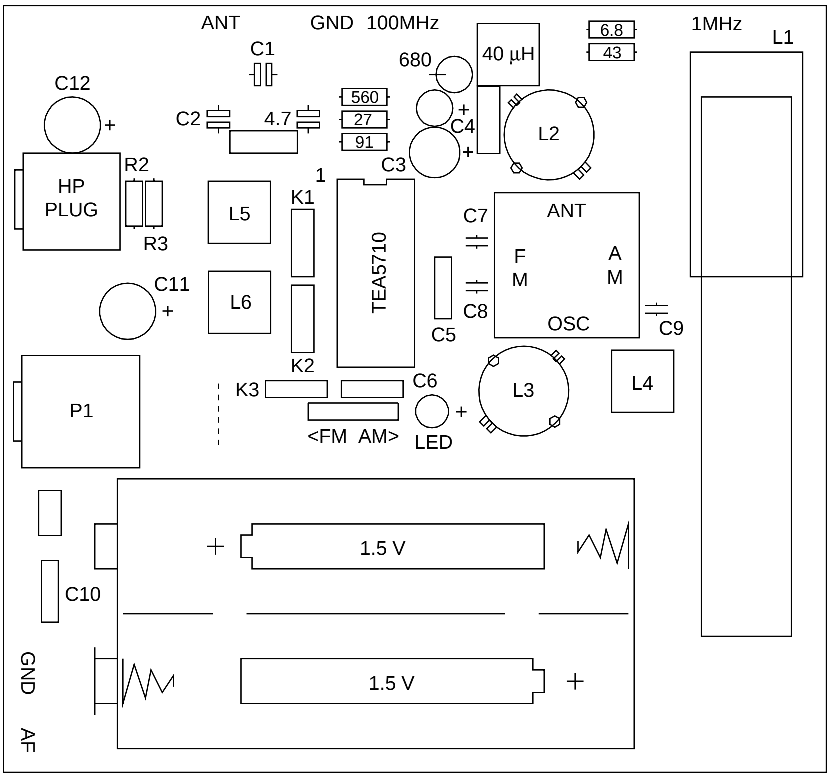


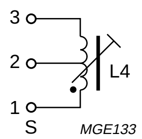
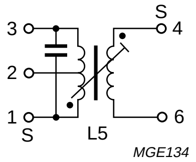
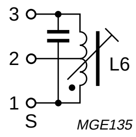
Fig.6 Printed-circuit board layout (track side) for application circuit of Fig.5.

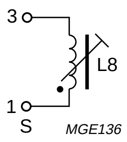


MGE110

Fig.7 Printed-circuit board layout (component side) for application circuit of Fig.5.

Components for Figs 4 and 5

Coils			
L1	AM-AERIAL	ferroceptor length = 6 cm L1-2 = 625 µH N1-2 = 105 turns	
L2	FM-RF	L1-2 = 66 nH N1-2 = 2.5 turns unloaded Q = 150 TOKO type S18 TOKO no. 301SS-0200	
L3	FM-OSC	L1-2 = 40 nH N1-2 = 1.5 turns unloaded Q = 150 TOKO type S18 TOKO no. 301SS-0100	
L4	AM-OSC	L1-3 = 270 µH N1-2 = 18 N2-3 = 70 unloaded Q = 100 wire diameter 0.07 mm TOKO type 7P material TOKO 7BRS	
L5	AM-IF1	L1-3 = 625 µH N1-2 = 17 turns N2-3 = 141 turns N4-6 = 10 turns C1-3 = 180 pF unloaded Q = 90 wire diameter 0.07 mm TOKO type 7P material TOKO 7MCS	
L6	AM-IF2	L1-3 = 625 µH N1-2 = 28 turns N2-3 = 130 turns C1-3 = 180 pF unloaded Q = 90 wire diameter 0.07 mm TOKO type 7P material TOKO 7MCS	

L7	FM-AERIAL	print-coil L1-2 = 60 nH N1-2 = 2.5 turns	
L8	AM-RF	test circuit only: L1-3 = 40 µH N1-3 = 34 turns unloaded Q = 85 wire diameter 0.09 mm TOKO type 7P material TOKO 7BRS	
Ceramic filters			
K1	FM-IF1	Murata SFE 10.7 MS 3	
K2	FM-IF2	Murata SFE 10.7 MS 2	
K3	FM-DET	Murata CDA 10.7 MC 40	
Capacitors			
C1	VARICON	AM: 140/82 pF FM: 2 × 20 pF trimmer: 4 × 8 pF TOKO type no. HU-22124	

Application notes

1. Short circuiting: **all** pins are short-circuit proof except **pin 1** (FM-RF_I) with respect to the supply voltage pin.
2. Tuning indicator (at pin 15, IND): connect either a tuning indicator (e.g. a LED) between this pin and the supply voltage (pin 16) or connect the pin IND to ground.
3. For an example of PC-board layout: see Figs 6 and 7.

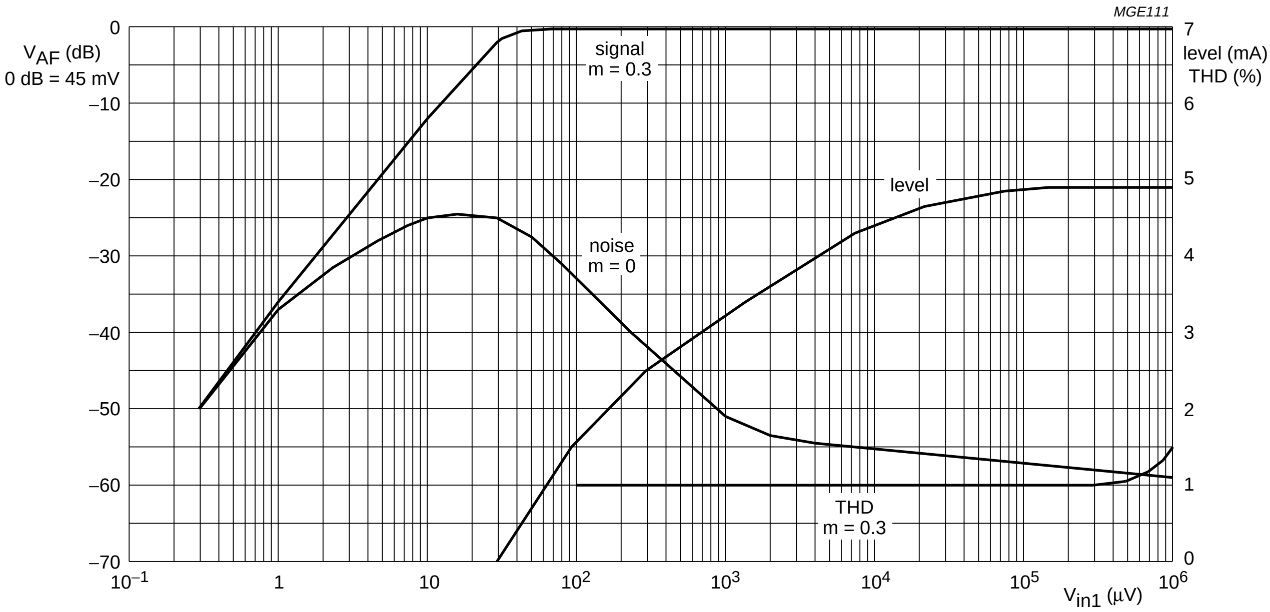


Fig.8 Typical AM audio output voltage (V_{AF}; signal at m = 0.3), noise, THD (at m = 0.3) and indicator current (level) as a function of RF input voltage (V_{in1}; f = 1 kHz). Measured in test circuit of Fig.4 with V_P = 3.0 V.

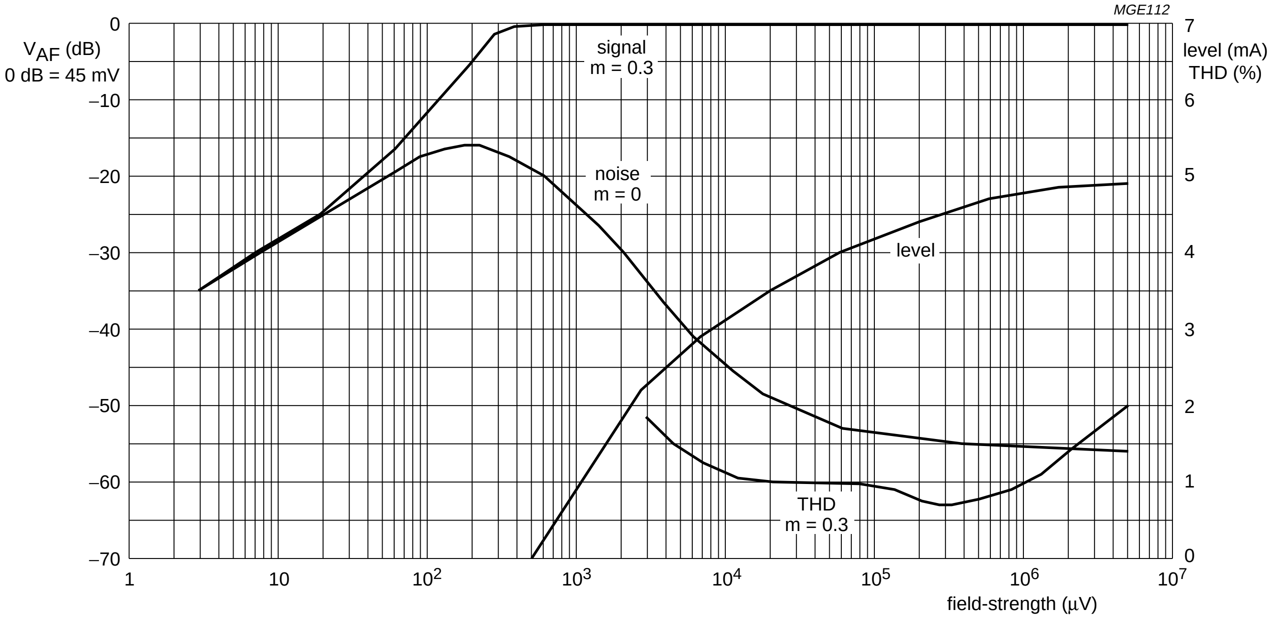


Fig.9 Typical AM audio output voltage (V_{AF}; signal at m = 0.3), noise, THD (at m = 0.3) and indicator current (level) as a function of field-strength (f = 1 kHz). Measured at 1 MHz in application circuit of Fig.5 with V_P = 3 V.

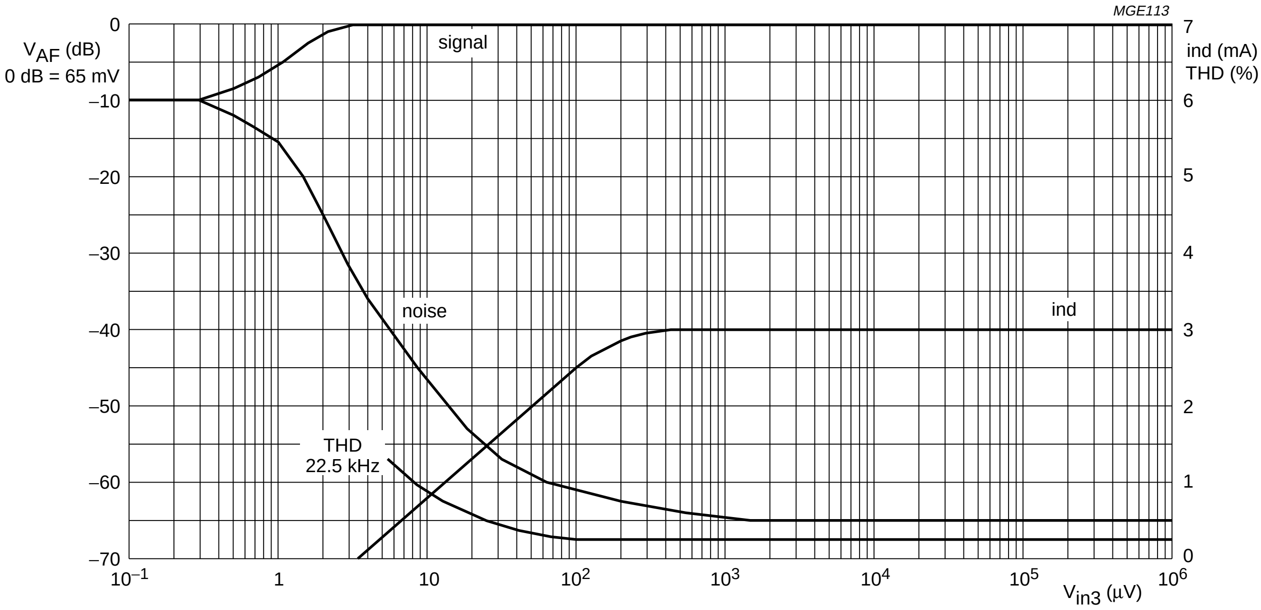
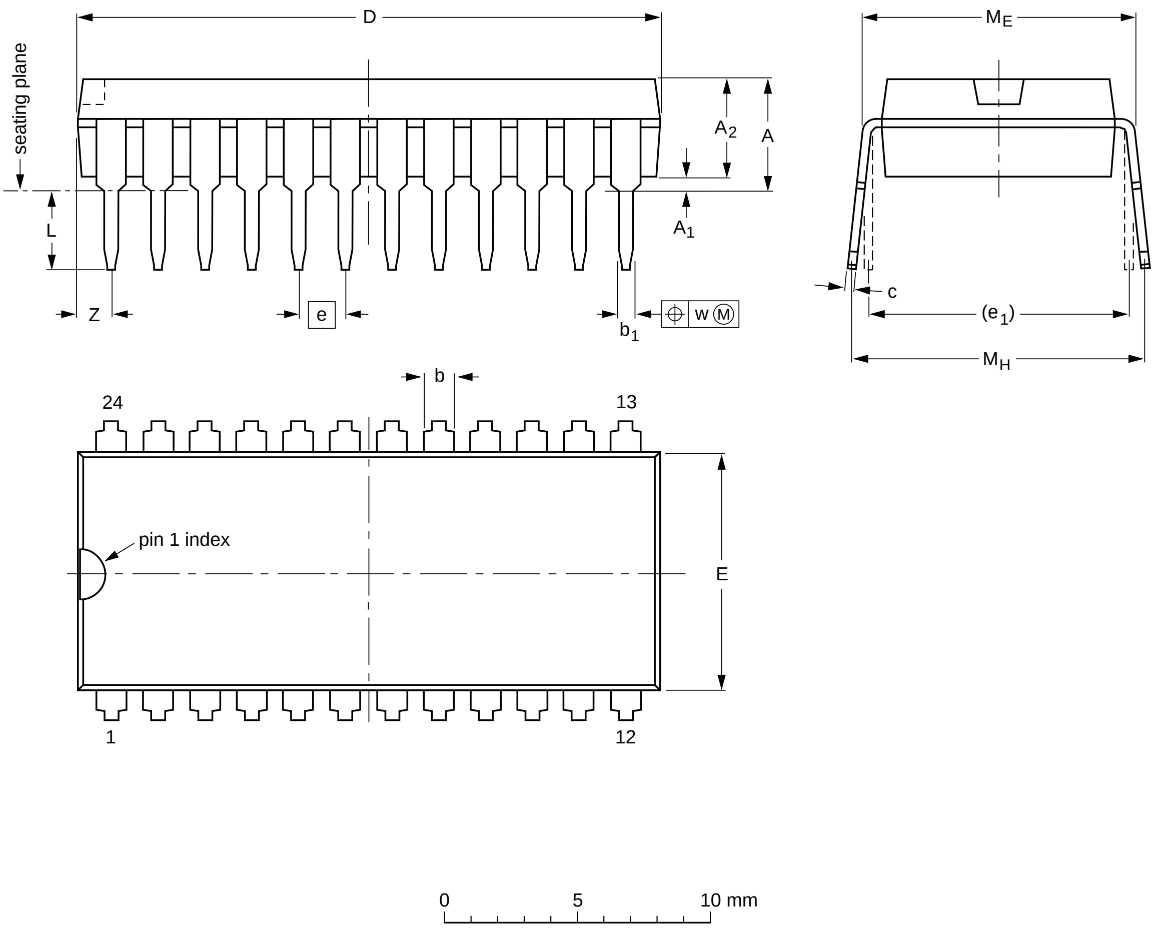


Fig.10 Typical FM audio output voltage (V_{AF}; signal), noise, THD and indicator current (ind) as a function of RF input voltage (V_{in3}; d_f = 22.5 kHz). Measured in test circuit of Fig.4 at V_P = 3 V.

PACKAGE OUTLINES

SDIP24: plastic shrink dual in-line package; 24 leads (400 mil) **SOT234-1**



DIMENSIONS (mm are the original dimensions)

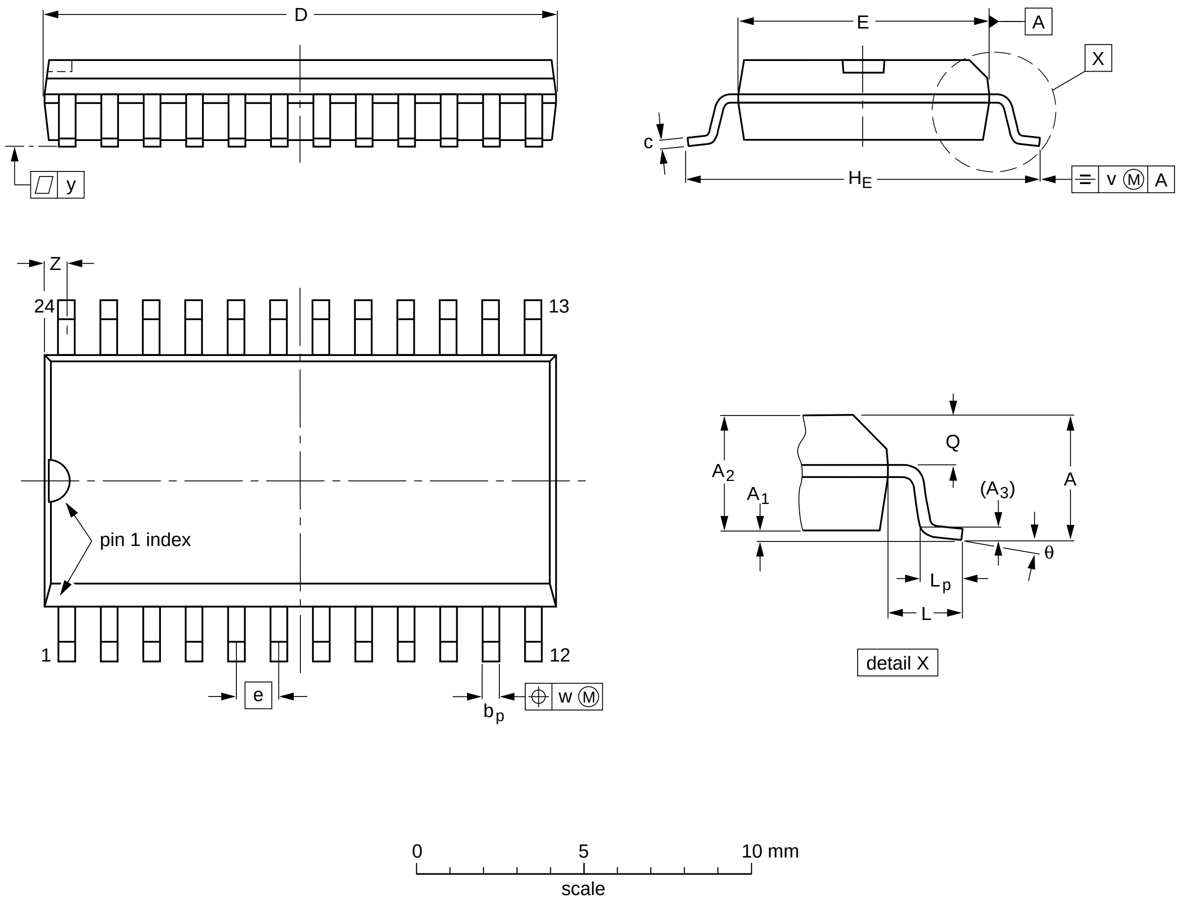
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.8	1.3 0.8	0.53 0.40	0.32 0.23	22.3 21.4	9.1 8.7	1.778	10.16	3.2 2.8	10.7 10.2	12.2 10.5	0.18	1.6

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT234-1						~~92-11-17~~ 95-02-04

SO24: plastic small outline package; 24 leads; body width 7.5 mm **SOT137-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT137-1	075E05	MS-013AD				~~92-11-17~~ 95-01-24

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

SDIP

SOLDERING BY DIPPING OR BY WAVE

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

REPAIRING SOLDERED JOINTS

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

SO

REFLOW SOLDERING

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

WAVE SOLDERING

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

REPAIRING SOLDERED JOINTS

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

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